Wire stripping apparatus.

Patent number: EP0401984
Publication date: 1990-12-12
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Classification:
- international: ***B24B5/38; H02G1/12;*** **B24B5/00; H02G1/12;** (IPC1-7): H02G1/12
- european: B24B5/38; H02G1/12E
Application number: EP19900305210 19900515
Priority number(s): US19890362088 19890606

Also published as:
US5016398 (A1)
JP3022809 (A)
EP0401984 (B1)

Cited documents:
GB1225716
DE2540933
US2359568

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Abstract of **EP0401984**

A housing (12) encloses a pair of stripping assemblies (52) adjustably mounted for rotation about a central axis (49) on a rotatable frame (50) which is driven by a motor (42). Each stripping assembly (52) includes a stripping wheel (54) positioned to abrade the surface of a wire inserted along the central axis (49). In one arrangement each stripping assembly (52) comprises a pair of bearing blocks (58, 59) which mount the stripping wheel (54) to be driven via a pair of spur gears (64, 66). The drive gear (66) is affixed to a drive roller (62) which is driven by rolling contact with the transverse inner surface (72) of the end of the housing (12). In another embodiment, the stripping wheels (228) are mounted on the same shafts (226) as their respective drive gears (230) which are rotated by engagement with a series of pins (240) mounted in a circle and contacted in succession by the drive gears (230) as the assemblies (222) revolve about the central axis. The stripping wheel assemblies (222) are adjustable radially inward or outward to accommodate different wire sizes. An alternative version has a hollow central shaft (146) mounting a pulley (149) which is coupled to be driven by an offset motor (142). This latter version includes actuators (160) for retracting and extending the stripping assemblies (153, 154) at appropriate points so that wire may be continuously fed through the device while the stripping of selected portions thereof is accomplished in a step-and-repeat operation.

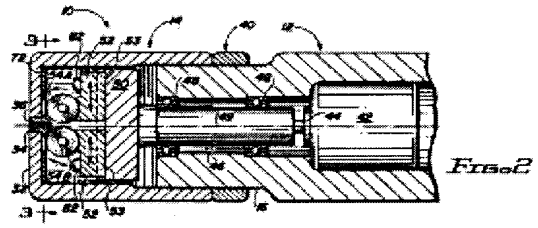

Fig. 2

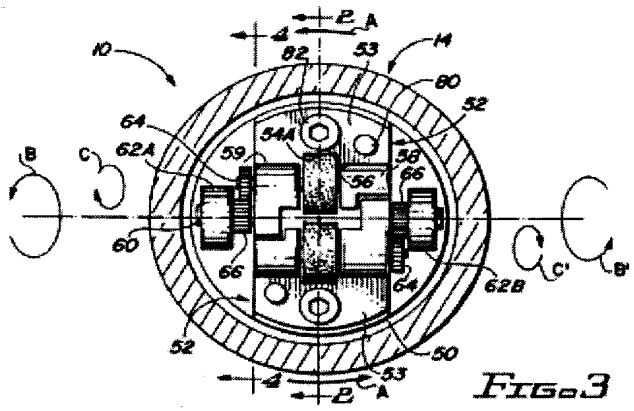

Fig. 3

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 401 984 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90305210.8**

(51) Int. Cl.5: **H02G 1/12**

(22) Date of filing: **15.05.90**

(30) Priority: **06.06.89 US 362088**

(43) Date of publication of application:
12.12.90 Bulletin 90/50

(84) Designated Contracting States:
AT CH DE ES FR GB IT LI SE

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(54) Wire stripping apparatus.

(57) A housing (12) encloses a pair of stripping assemblies (52) adjustably mounted for rotation about a central axis (49) on a rotatable frame (50) which is driven by a motor (42). Each stripping assembly (52) includes a stripping wheel (54) positioned to abrade the surface of a wire inserted along the central axis (49). In one arrangement each stripping assembly (52) comprises a pair of bearing blocks (58, 59) which mount the stripping wheel (54) to be driven via a pair of spur gears (64, 66). The drive gear (66) is affixed to a drive roller (62) which is driven by rolling contact with the transverse inner surface (72) of the end of the housing (12).

In another embodiment, the stripping wheels (228) are mounted on the same shafts (226) as their respective drive gears (230) which are rotated by engagement with a series of pins (240) mounted in a circle and contacted in succession by the drive gears (230) as the assemblies (222) revolve about the central axis. The stripping wheel assemblies (222) are adjustable radially inward or outward to accommodate different wire sizes. An alternative version has a hollow central shaft (146) mounting a pulley (149) which is coupled to be driven by an offset motor (142). This latter version includes actuators (160) for retracting and extending the stripping assemblies (153, 154) at appropriate points so that wire may be continuously fed through the device while the stripping of selected portions thereof is accomplished in a step-and-repeat operation.

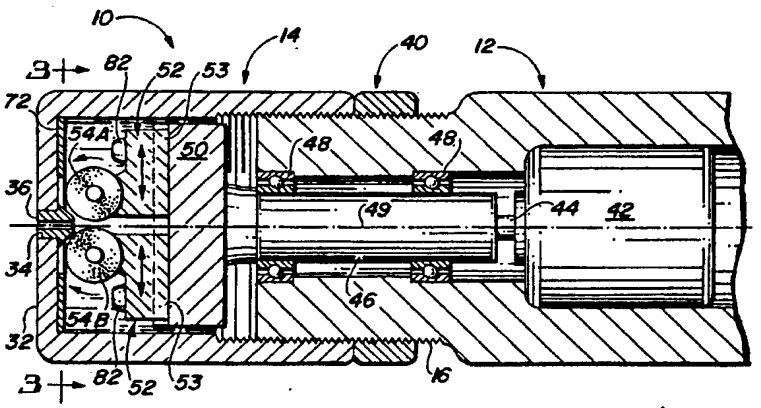

FIG. 2

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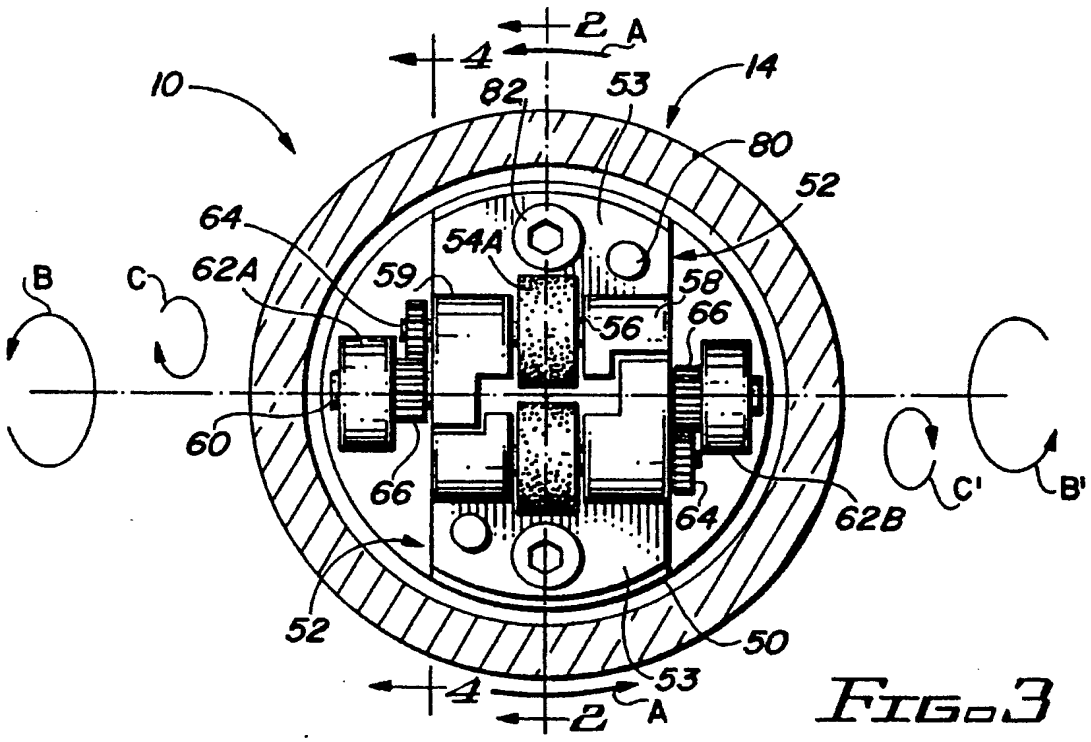
2
A
4
10
82
53
14
80
52
64
54A
B
C
62A
59
58
56
66
60
66
64
62B
C'
B'
52
50
53
4
2
A

FIG. 3

WIRE STRIPPING APPARATUS

This invention relates to wire stripping apparatus for removing insulating coating from electrical conductor wire.

Magnet wire, transformer wire, etc. is commonly coated with a varnish insulation. Some of these wires are extremely fine, as small as about .003 inches in diameter. Removal of the insulation is sometimes difficult with known wire stripping apparatus. The wire may be dipped in a chemical etchant, but that is unacceptable in many instances because of the potentially corrosive residue which may remain on the wire.

Insulating coatings other than varnish may comprise materials of enamel, plastic, nylon, woven glass, Teflon, P.V.C., neoprene, rubber, polyamide and the like. Stationary strippers for such insulation are known which have a wire guide into which the wire may be inserted for stripping contact between two oppositely rotating abrading wheels. Similar devices are used which have rotating brushes, rather than abrading wheels, to accomplish the stripping of insulation.

However, in those devices which are known, the pivot axes of the abrading wheels or brushes are fixed so that the wire is only stripped along two surfaces 180 degrees apart. The wire must be rotated in devices of this type in order to be able to strip the insulation all the way around the wire. This is sometimes difficult to accomplish without damaging the wire, particularly where the wire is extremely fine or ductile.

Embodiments of the present invention comprise a housing having a generally flat planar end with a central bore in which a wire entry guide is mounted. This guide is removable to permit replacement with guides of different sizes to accommodate different sizes of wire. Within the housing, coaxially aligned with the entrance bore, is a rotatable shaft mounted in support bearings. The shaft supports a pair of rotatably driven roller wheel assemblies in a juxtaposition such that the stripping wheels are positioned adjacent the wire guide and on opposite sides of the central axis. The radial position of the stripping wheels relative to the central axis of the housing is adjustable within a predetermined range to permit use of the device with different sizes of wire and insulation.

In one particular embodiment of the invention a drive roller is mounted in each corresponding assembly to rotate the associated stripping wheel on its axis as the assembly is rotated about the central axis. In each stripping wheel assembly, the drive roller and stripping wheel are mounted for rotation on shaft axes which are parallel to but displaced from each other. These shaft axes are orthogonal to the direction of the central axis. The two shafts carry spur gears which intermesh so that rotation of the drive roller causes the stripping wheel to rotate. The drive roller shafts of the two assemblies are mounted so as to be in line with each other along a diameter of the housing. The drive rollers are mounted near the outboard ends of the assemblies adjacent the inner surface of the cylindrical bore of the housing.

The inner face of the end of the housing is generally flat and planar across the end of the hollow cylindrical bore and forms a cup-shaped end portion of the housing which is threadably connected to the main portion of the housing. The cup-shaped end portion can be readily removed to permit adjustment of the radial position of the stripping wheels, cleaning of the stripping wheels, removal of debris and dust from the wire insulation, and the like. A flat annular ring member, somewhat like a washer, is mounted to the end wall inner face. This may be fabricated of rubber or some like frictional surface material, in which case it is affixed to the end wall inner surface by a suitable adhesive. In such a case, the drive rollers may be of metal, possibly with a machined peripheral surface adapted to develop better frictional engagement with the annular member. Alternatively, the flat annular member may be machined as a portion of the inner face of the housing end portion, in which case the drive rollers should be of rubber or a similar resilient frictional material or of metal having an outer surface layer of rubber or similar resilient material.

The embodiment just described serves to produce rotation of the abrasive stripping wheels in opposite directions when driven by the drive rollers. The entire unit within the housing, comprising the drive shaft, associated support frame and the two drive roller/stripping wheel assemblies, rotates with the drive shaft. When this occurs, the drive rollers are driven to rotate through the frictional engagement with the flat annular end track, thus driving the stripping wheels to rotate through the intercoupled gearing arrangements. At the same time, the stripping wheels revolve about the axis of the housing along which the wire being stripped extends. Thus, the abrading or stripping action occurs about all sides of the wire so that the insulation is removed evenly throughout the complete circumference of the wire. Since the wire does not have to be rotated manually to expose the insulation on all sides to the abrading wheels, a more even, delicate stripping operation is achieved, and the wire is less likely to be damaged by the stripping device, particularly where extremely fine

wires are involved.

In another embodiment of the present invention, the drive mechanism for the stripping wheel of the respective stripping wheel assemblies comprises a directly driven gearing arrangement instead of the frictional drive rollers of the first-mentioned embodiment. Near the front end or face of the wire stripping apparatus of this embodiment, mounted within the cylindrical housing, is a pin gear plate having a central bore through which the rotatable shaft supporting the two stripping wheel assemblies extends. In this embodiment, each stripping wheel is directly driven by a gear mounted on the stripping wheel shaft. The gearing arrangement is similar to a rack and pinion gear, except that the rack portion extends in a circle, rather than being straight, and comprises a plurality of pins having rounded ends extending from the pin gear plate in place of gear teeth. The "pinion" gear has a plurality of teeth especially formed to accommodate intermeshing and sliding engagement with the individual pins as the stripping wheel assemblies revolve about the central axis, the stripping wheels being driven by their respective coaxial pinion gears which are rotated by engagement with the pins of the pin gear plate. The action of the stripping wheels in removing insulation from wires inserted between the stripping wheels along the central bore of the apparatus is the same as that described hereinabove for the first embodiment. It has been found, however, that this arrangement operates with substantially less friction, and therefore requires less driving power, than is encountered in the first-mentioned embodiment.

In one version of the present invention, the unit is a small, hand-held device with a self-contained electric motor coupled to rotatably drive the central shaft. A finger switch in the housing wall permits the operator to control power to the motor, either from a self-contained power pack or from local AC mains.

In another version of the present invention, the unit is designed to be bench-mounted and its central shaft is coupled to an external pulley which may be driven by an associated electric motor. The central drive shaft is hollow, having a bore which extends out the rear end of the device, through the drive pulley. The drive roller/stripping wheel assemblies are mounted to the shaft by means of actuators which extend and retract the stripping wheels from operative positions adjacent the central axis. This enables the device to remove insulation from selected portions of the wire as it is fed through the unit. After stripping in this manner, the wire is fed to a cutting machine to be cut at the stripped portions so that individual lengths of wire having stripped ends are provided. With this version, the wire may be fed and stripped rapidly at selected portions in a type of step-and-repeat operation with the stripping being effected at one portion about the circumference of the wire, after which the actuators retract the stripping wheels radially outwardly, the wire is fed through the device (in through the wire guide and out through the hollow bore of the shaft at the rear end thereof) by a predetermined distance according to the desired length of the stripped wire, and the actuators extend the stripping wheels radially inward to effect the stripping at the next portion of the wire.

Either of the two embodiments described hereinabove may be incorporated in the respective versions of the present invention as described herein.

In the drawing:

FIG. 1 is a perspective view of a hand-held wire stripping device in accordance with one embodiment of the present invention;

FIG. 2 is a side sectional view of a portion of the device of FIG. 1;

FIG. 3 is an end view, in section, of the device of FIG. 1;

FIG. 4 is another side sectional view of a portion of the device of FIG. 1;

FIG. 5 is a partial side sectional view of an alternative version of the embodiment of FIG. 1;

FIG. 6 is a schematic end view, partially broken away, of a second embodiment of the present invention; and

FIG. 7 is a schematic view showing the details of a portion of the embodiment of FIG. 6.

FIG. 1 shows a perspective view of a first embodiment of the present invention. In FIG. 1, a hand-held unit 10 is shown comprising a main housing portion 12 and an end housing portion 14 threadably connected via a threaded section 16. The main housing portion 12 includes a generaiiy cylindrical hand grip 18 tapering at a cone-shaped portion 20 to a distal end to which an electrical lead 22 is attached. A finger switch 24 is connected in the circuit to a motor within the portion 18.

The end portion 14 comprises a hollow bore housing section 30 terminating in a flat, planar, transverse end wall 32, in the center of which is an opening 34 containing a wire guide for admitting a wire to be stripped by the unit 10.

FIGS. 2, 3 and 4 show details of the internal apparatus of the unit 10 of FIG. 1. As particularly shown in FIG. 2, a wire guide 36 is installed within the opening 34 in the end wall 32. Different wire guides 36 of different sizes may be installed to accommodate particular sizes of wire that are to be stripped. The cup-shaped end portion 14 is locked in place on threads 16 of the main housing 12 by means of a locknut 40. A motor 42 is shown within the main housing portion 12, having a shaft 44, 46

which is mounted in ball bearings 48 about the central axis 49 of the implement 10. Shaft 46 supports a rotatable frame 50 on which are mounted a pair of stripping assemblies 52. Each stripping assembly 52 includes a bracket 53 which supports a stripping wheel 54 mounted on a shaft 56 (see FIG. 3) in bearing blocks 58, 59. Bearing block 59 supports an additional shaft 60 on which a drive roller 62 is installed. The shafts 56 and 60 mount enmeshed spur gears 64, 66 in a drive arrangement which enables the rotation of the drive roller 62 to produce rotation of the associated stripping wheel 54.

The arrangement for causing rotation of the drive roller 62, and thus the gear train 64, 66 and shaft 56 of the stripping wheel 54 is shown in FIG. 4 which is a partial sectional view taken along the line 4-4 of FIG. 3, looking in the direction of the arrows. As is shown in FIGS. 2 and 4, the inner surface 70 of the end wall 32 is provided with an annular member 72. This serves as a frictional track or raceway for the drive roller 62 as the latter revolves about the central axis of the unit 10. In the particular embodiment shown, the drive roller 62 is a metal wheel and the track 72 is in the form of an annular washer-like member of a resilient material such as plastic or rubber. As an alternative, the drive roller 62 may be formed of a resilient material or have a "tire" or outer layer of resilient material, in which case the annular member 72 can be dispensed with and the drive roller could merely bear against the inner surface 70 of the end wall 32.

The operation of the device 10 can perhaps be best understood by reference to the view of FIG. 3. Rotation of the mounting frame 50, bearing the assemblies 52, in a counterclockwise direction as indicated by the arrows A within the end housing portion 14 produces a counterclockwise rotation of the left drive roller 62A as indicated by the arrow B, when viewed from the left-hand side of FIG. 3. Considering this motion in FIG. 4, the roller 62A moves downwardly, relative to the track 72, with rotation of the roller 62A shown in a clockwise direction (because it is viewed from the opposite end of its shaft 60).

As a result of the rotation of a the drive roller 62A in the counterclockwise direction, according to arrow B (FIG. 3), the stripping wheel 54A is rotated in the clockwise direction as indicated by arrow C (viewed from the left side of the figure). This translates in FIG. 2 to a counterclockwise direction of the upper stripping wheel 54A, when viewed from the opposite end of the shaft. The peripheral surface movement of the upper wheel 54A is away from the wire guide 36, thus always tending to draw the wire into the device 10. The direction of peripheral movement of the lower wheel 54B is in the same direction--away from the wire guide 36; thus both stripping wheels 54 tend to draw the wire being stripped into the device when it is operating. As viewed in FIG. 2, the lower stripping wheel 54B rotates in a clockwise direction, corresponding to the arrow C′ (FIG. 3) as driven by the gear train and associated drive roller 62B, the direction of which when viewed from the right-hand side of FIG. 3 is indicated by arrow B′.

As indicated by the vertical arrows in FIG. 2, the assemblies 52 can be adjusted in a radial direction on the rotatable frame 50 in order to accommodate different sizes of wire being stripped. Each of the assemblies 52 includes a bracket adjusting pin 80 and a bracket set screw 82 to control the radial position of the assembly 52.

A second version of the embodiment of FIG. 1 is schematically represented in FIG. 5 which shows a stationary frame 112 mounting a plurality of bearings 148 which rotatably support a hollow shaft 146. Frame 112 is adapted for mounting on a bench or the like in association with a separate drive motor 142. The motor 142 and shaft 146 are equipped with drive pulleys 147, 149 or equivalent sprockets so that the shaft 146 may be rotated by the motor 142 via suitable drive belts, gear belts or the like.

The mechanisms for supporting and driving the stripping wheels 154 are essentially like those shown and described in connection with FIGS. 2-4. Each stripping wheel 154 is coupled to, and is driven by, a suitable gear train and drive roller arrangement (not shown), the drive roller being forced to rotate in driving relationship as it moves along a raceway member 172 on the inner surface of the end wall 132.

Each of the support assemblies 152 is mounted for radial displacement in a corresponding actuator 160 which is installed on the rotating shaft 146. The actuators 160 are controlled by electrical signals coupled into the rotating assembly of the device 100 by means of conventional current-conducting rings and brushes or wiper contacts, not shown. The apparatus of FIG. 5 is designed to be used in conjunction with a wire cutting machine (not shown) which operates in a step-and-repeat mode to draw wire 100 past a cutting knife by a predetermined length, stop the wire movement while the knife is activated to cut the wire, and then advance it again by the next length to be cut. The embodiment of FIG. 5 is operated in conjunction with this step-and-repeat procedure so that when movement of the wire 100 is stopped, the actuators 160 are controlled to move the assemblies 152 radially inward so that stripping of the insulation 102 can occur. Relative movement of the wire 100 by a limited amount while the wire at the cutting station is held stationary will be controlled so that

the desired stripping dimension 104 is realized. This dimension 104 conventionally is twice the desired length of the stripped ends of the cut wires, since the wire 100 will be cut in the middle of the bare section.

FIGS. 6 and 7 are schematic representations of a second embodiment of the drive mechanism for the wire stripping assemblies of the present invention. FIG. 6 schematically represents an end view of a wire stripping implement 10′, having an end wall 32′ in the form of a cover plate mounting a central opening 34′ which contains a wire guide for admitting wire to be stripped by the unit 10′. The cover plate 32′ is shown broken away along a vertical axis to illustrate the driving arrangement on the left half of FIG. 6.

On the left side of FIG. 6 is shown a transversely mounted pin plate 210 which may be in the form of a disk 212 mounted to the housing 214 by means of mounting screws 216. The disk 212 has a central opening 220 through which the respective stripping wheel assemblies 222 extend, mounted on suitable bearings (not shown) for rotation about the central axis of the implement 10′ which is aligned with the wire guide 34′. Each of the wire stripping assemblies 222 comprises a mounting frame 224 having bearings (not shown) supporting a shaft 226 on which a stripping wheel 228 and a drive gear 230 are mounted so that the drive gear 230 may rotatably drive the stripping wheel 228 to develop the stripping action of a wire inserted through the wire guide 34′.

The pin plate 210 has a plurality of pins 240 mounted in a circle thereon, preferably inserted in transverse holes drilled in the plate 210. One such pin 240 is shown in the schematic diagram of FIG. 7, illustrating the way in which it engages gear teeth of the drive gear 230 and causes the gear 230 to rotate on the axis of its shaft 226 as the wire stripping assembly 222 is rotatably driven to revolve about the central axis. The gear 230 is provided with a plurality of teeth 242, better shown in FIG. 7, which are especially curved so as to engage successive pins 240 as the gear 230 traverses the pin circle in the plate 210. It will be appreciated that the teeth 242 of the gear 230 must accommodate relative sliding movement of the pin 240 along the operative face of the engaged gear tooth 242, since a pin 240 enters the space between two adjacent teeth 242 near the radially inward end thereof, moves radially outward relative to the gear 230 and then moves radially inward again as it approaches the exit point. The gear teeth 242 are especially shaped so that the point of surface contact of the tooth is parallel to the point of surface contact of the contacting pin 240. This drive arrangements develops very little friction, as compared with the arrangement described in conjunction with FIGS. 2-5, and can be driven with less power. The effect of the wire stripping wheels 228 is the same as that described for the wire stripping wheels 54 of the other arrangement. Radial adjustment of the wire stripping assemblies is permitted in order to accommodate different sizes of wire to be stripped. The drive arrangement of FIGS. 6-7 can be used in place of the particular arrangement of FIGS. 2-4 in the version depicted in FIG. 5.

Embodiments of the present invention advantageously provide for improvements in the efficiency and effectiveness of wire stripping apparatus. In accordance with one embodiment of the invention, a particularly small, compact, hand-held wire stripper is provided which can be used as a portable tool for stripping wires in making circuit repairs at the site of electrical equipment, or it may be used at a work station on a production line. In any case, the operation of apparatus in accordance with the invention results in a complete, even removal of wire insulation all around the wire without the operator having to twist the wire as it is being stripped. The stripping of the insulation is accomplished by means of drawing forces only which are exerted on the wire, thus making it feasible to use the device with extremely fine, ductile wires down to as small as .003 inches in diameter. A second embodiment of the invention achieves similar beneficial results by using the equivalent wire stripping mechanism in a manner which permits drawing the wire entirely through the apparatus, thereby adapting the invention for use in conjunction with conventional step-and-repeat wire cutting machines.

Claims

1. Wire stripping apparatus (10) including a frame member (50) supported for rotation about a central axis (49), a housing (12) at least partially enclosing the frame member (50) and having a transverse wall (32) at one end with an opening (34) in line with the central axis for receiving wire to be abraded for the stripping of a coating therefrom, a pair of opposed assemblies (52) mounted on the frame member (50) for rotation therewith, each assembly (52) including an abrading wheel (54) mounted for rotation about an axis orthogonal to the central axis in order to abrade an adjacent surface of a wire which is received through the opening (34) by relative movement of the peripheral surface of the wheel (54) against the wire, characterized by the axis of rotation of each abrading wheel (54) being displaced from the central axis such that the relative movement of the peripheral surface of the wheel (54) with respect to the wire is in a direction parallel to the central axis when the wheel is rotated about its axis and further

characterized by a mechanism (62, 64, 66) in each assembly (52) for driving the abrading wheel (54) thereof to rotate about its axis as the assembly (52) revolves with the frame member (50) about the central axis while abrading the surface of the wire in a direction parallel to the central axis.

2. The apparatus of claim 1 wherein the driving mechanism includes a drive roller (62) bearing against the transverse wall (34) and coupled to rotatably drive the abrading wheel (54).

3. The apparatus of claim 2 wherein the inner surface of the transverse wall (32) includes a circular raceway (72) adjacent the outer periphery of the transverse wall (32) and adapted to frictionally engage the drive rollers (62) of the assemblies (52).

4. The apparatus of claim 1 wherein the driving mechanism includes a plurality of drive elements (240) mounted in a circle which is oriented generally orthogonally to the central axis and concentric therewith and a gear (230) mounted on a shaft (226) with an associated abrading wheel (228) in a position to be rotated by the drive elements as the assembly revolves about the central axis.

5. The apparatus of claim 4 wherein the drive elements (240) comprise a plurality of drive pins inserted in mounting holes in a transversely mounted pin plate (210).

6. The apparatus of claim 5 wherein the gear (230) has a plurality of teeth (242) which are especially shaped to accommodate relative sliding movement between the gear teeth (242) and the drive pins (240) as the gear moves about the circle of the pins.

7. The apparatus of claim 5 or claim 6 wherein the gear teeth (242) are shaped to develop parallelism between the contact surface of a gear tooth and the contact surface of a contacting pin at all points of contact between a tooth and pin.

8. The apparatus of any of claims 1-7 further characterized by the abrading wheels (54) revolving completely about the central axis as the wheels (54) rotate on their respective axes to abrade a wire extending along the central axis completely about the circumference of the wire.

9. The apparatus of any of claims 1-8 wherein the direction of rotation of both abrading wheels (54) about their respective axes is such as to apply tension to a wire entering the opening in the transverse wall (32) in order to draw the wire into the housing (12) as the external surface of the wire is being abraded.

10. The apparatus of any of claims 1-9 further including a wire guide (36) removably mounted in the transverse wall (32) and having a guide opening selected to match the size of the wire to be abraded.

11. The apparatus of any of claims 1-10 further including a motor (42) and a central motor shaft (44) positioned within said housing in alignment with the central axis and coupled to drive the frame member (50) in rotation about the central axis.

12. The apparatus of any of claims 1-10 further including a motor positioned outside the housing (12) and coupled to drive the frame member (50) in rotation about the central axis, further characterized by the housing having an exit end opening remote from the transverse wall opening (34) for permitting wire to be fed out of said apparatus (10) after it has been abraded.

13. The apparatus of any of claims 1-12 wherein the assemblies (52) are radially adjustable relative to the frame member (50), and further including a mechanism (80, 82, 160) for adjusting the position of the assemblies (52) on the frame member (50) relative to the central axis.

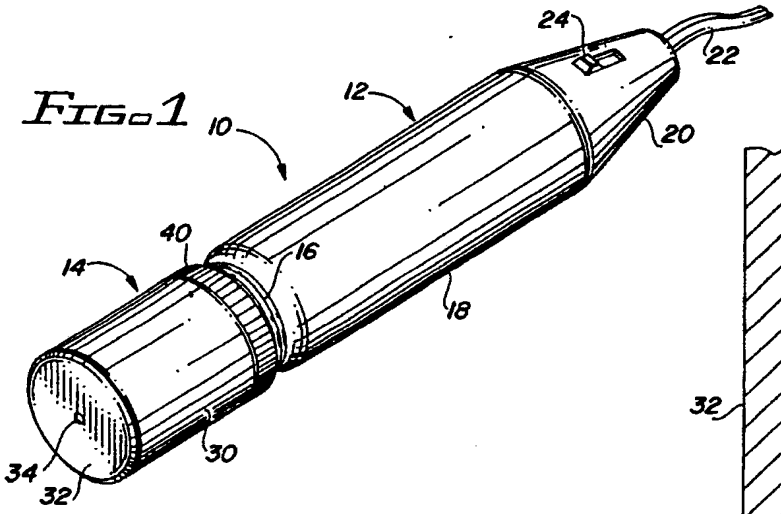

FIG. 1

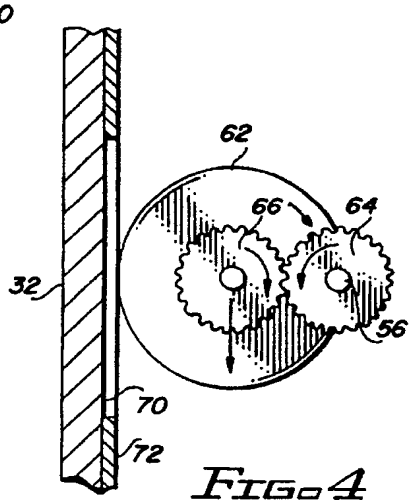

FIG. 4

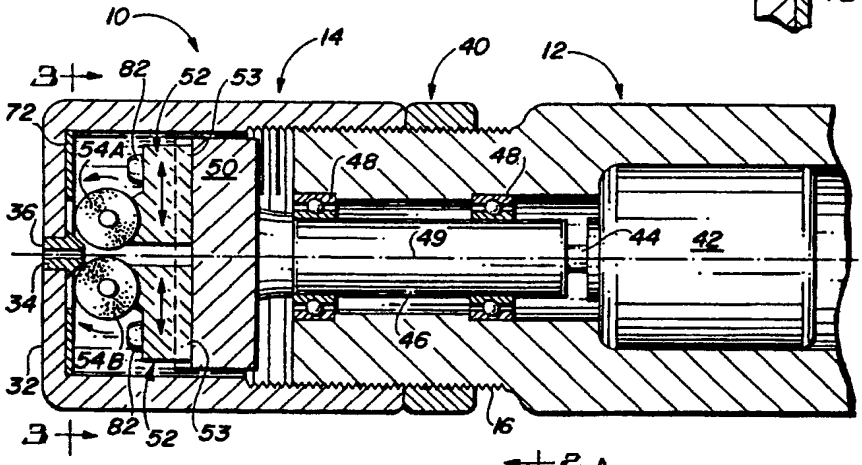

FIG. 2

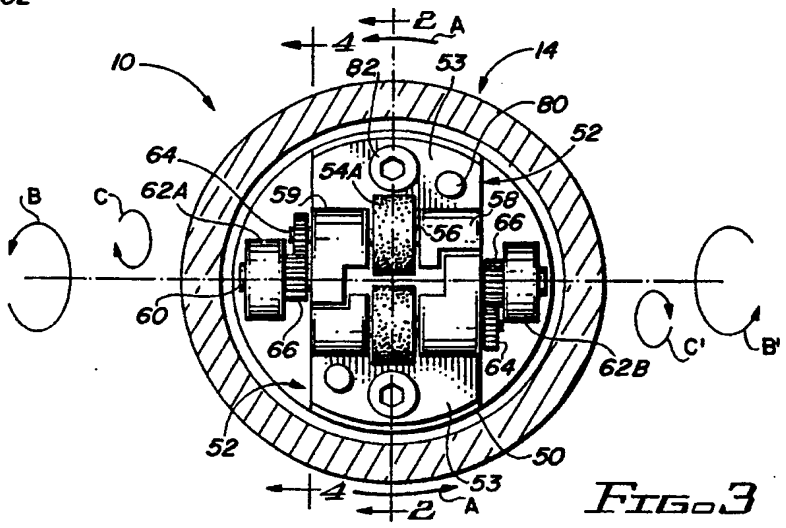

FIG. 3

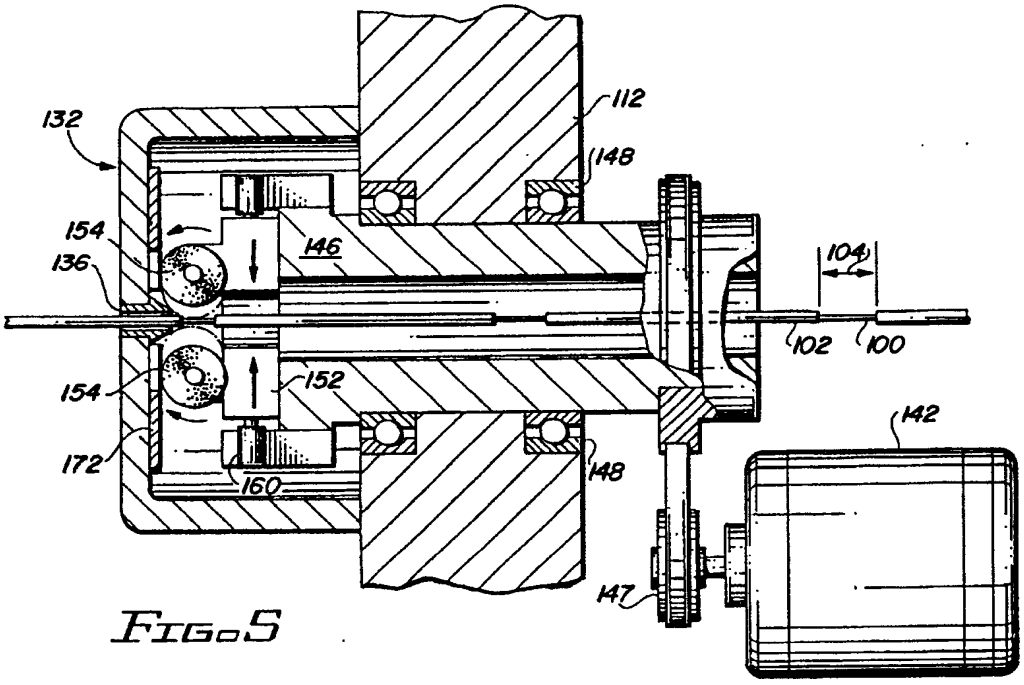

FIG. 5

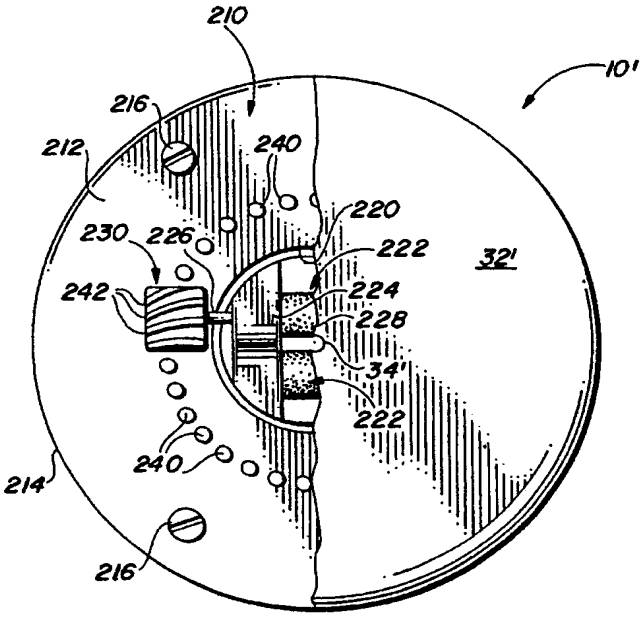

FIG. 6

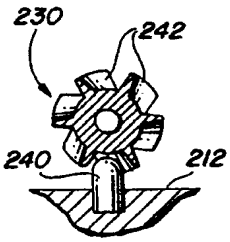

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 30 5210

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	GB-A-1225716 (VORONTSOV) * page 1, line 80 - page 2, line 48; figures 1, 2 *	1, 8	H02G1/12
A		11, 13	
Y	DE-A-2540933 (TRANSFORMATOREN UNION) * page 6, paragraphs 4 - 5; figures 1, 2 *	1, 8	
A		10, 11, 13	
A	US-A-2359568 (LOGAN) * page 1, column 1, line 53 - page 2, column 2, line 27; figures 1, 2 *	1, 2, 4-6	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H02G
H01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 SEPTEMBER 1990	DEMOLDER J.

CATEGORY OF CITED DOCUMENTS

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